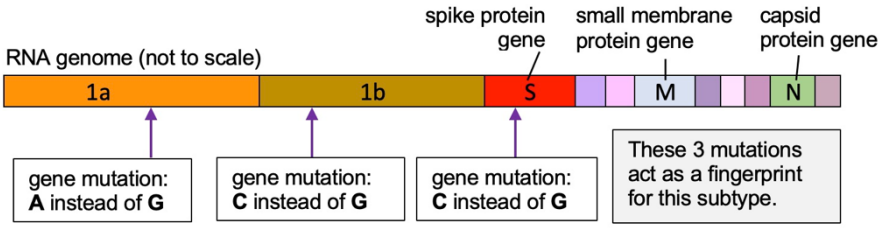
14 Evolution & COVID-19

Links:
- *Exploring Science* 9Ae
- *Edexcel 9-1* CB3b/e/f, CB4a/b

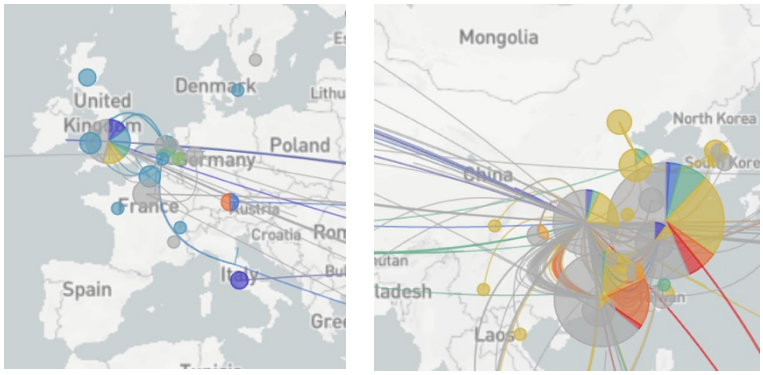
Mutations



A **genome** is all the genetic material in an organism or virus. The genome of SARS-CoV-2 is made of **RNA** (similar to a single strand of DNA). It contains 15 **genes** that contain the codes for making different proteins. Some of the genes are shown as coloured blocks in the diagram.

The 'spike protein' sticks out of the virus, and locks onto the ACE-2 protein on lung cells. The virus causes the cell to make copies of it. When its RNA is copied, mistakes (**mutations**) can occur — a wrong **base** is used. Most mutations have no effect but some produce proteins with different shapes.

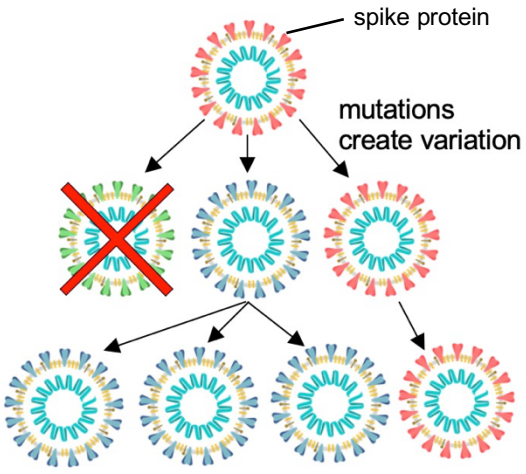
Over time, many mutations occur. They act as a 'fingerprint' and are used to track how the virus spreads and changes. Viruses with the same mutations are 'subtypes', and come from the same place. The map shows the tracking of some subtypes (in different colours) near the start of the pandemic.



The A2 subtype has a mutation in the S gene, which alters the spike protein's shape. This may make it better at attaching to lung cells, allowing it to infect more easily and so spread more quickly.

Natural selection

Mutations mean that there is a lot of **variation** between SARS-CoV-2 viruses around the world. Some variations weaken a virus (e.g. so that it falls apart easily). Others make it kill people very quickly (before those people can spread the virus). Viruses with these mutations are unlikely to survive long. Other mutations allow a virus to spread more quickly. This may be why the A2 subtype is currently the most common. When the environment filters out some variations and allows others to survive and spread, we call it **natural selection**.

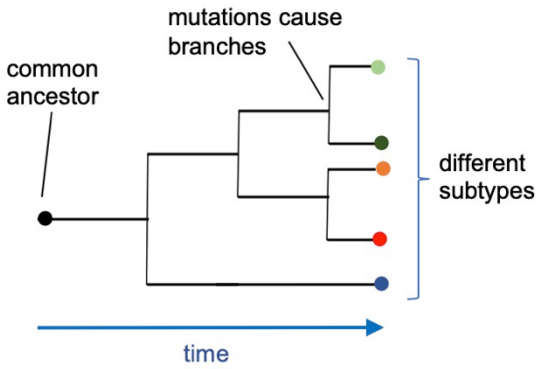


some mutations help the virus to spread better than others

In time, as the A2 subtype spreads, the original SARS-CoV-2 virus may cease to exist. A2 is a changed version of the original virus and we say that the original SARS-CoV-2 has **evolved**. (**Evolution** is the word used to describe a gradual change in characteristics over time.)

Find out

I. Go to https://nextstrain.org/ncov/europe and make sure 'Clade' is selected under 'Color by' on the left. A 'clade' is the same as a 'subtype'. This sort of diagram is a phylogenetic tree. It shows how different subtypes evolve.



1. List the named subtypes (clades) in Europe. (The ones in grey have no names yet.)

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2. In which the month was common ancestor of all these subtypes found? _____

3. Which subtype has the most variation? _____

Test yourself

4. Describe a cause of mutations in the virus genome. _____

5. On the 28th of January a businessman in Munich tested positive for SARS-CoV-2. Explain how it was worked out that the subtype he had was originally from Shanghai in China.

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6. The sentences describe natural selection. Add numbers to show the order that they occur.

1	Mutations occur in one type of organism living in an area.		Organisms with variation D survive better than others.
	This natural selection occurs over and over; the group of organisms evolves.		In the next generation more organisms have variation D.
	All the surviving organisms increase in number.		This produces variations in characteristics (A – D).
	The environment in the area changes.		

7. Scientists have identified hundreds of mutations in SARS-CoV-2. However, mutations are never found in certain parts of its genome. Suggest a reason why.

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Check-up

I. Check your answers.

II. Evolution occurs in many areas, not just biology. Prepare a short report on the evolution of mobile phones. Include the reasons why certain variations have survived. You could even show some of this evolution using a tree diagram, similar to the one at the top of the page.